

In The Claims:

Listing of the claims:

Claim 1-(Currently amended)

Claim 2-(Original)

Claims 3-36 (Newly added)

Pending Claims:

1. (Currently amended) A method of producing ~~durable~~ indelible ink imprinted indicia upon a selected substrate comprising:
 - a) printing an image upon ~~a-said~~ substrate with UV curable ink,
 - b) providing an UV energy source,
 - c) surrounding said UV energy source with an elongated, open end elliptical reflector whereby said UV energy is directed to a distant focal point thereby forming ~~an elongated V-shaped~~ converging radiation field,
 - d) passing said substrate through said UV converging radiation zone between said reflector and said focal point.
2. (Original) The method as claimed in claim 1 wherein said UV energy source is an elongated UV lamp.
3. (New) The method as claimed in claim 1 including the step of preheating said imprinted UV curable ink image before passing said image through said converging radiation field.

4. (New) A method of producing indelible ink imprinted indicia upon a selected substrate comprising:

- a) printing an image upon said substrate with UV curable ink,
- b) providing an UV energy source,
- c) surrounding said UV energy source with an open end elliptical reflector whereby said UV energy is directed to a distant focal point thereby forming a converging radiation field, above said focal point and an extended, diverging radiation field below said focal point,
- d) passing said substrate through said extended, diverging radiation field below said focal point.

5. (New) The method as claimed in claim 4 including the step of preheating said imprinted UV curable ink image before passing said image through said extended, diverging radiation field.

6. (New) A method of producing indelible ink imprinted indicia upon a selected substrate comprising:

- a) printing an upon said substrate with UV curable ink,
- b) providing a remote UV energy source,
- c) providing a light pipe extending from said remote UV energy source whereby said UV energy may be transmitted through said light pipe and emitted from the distal end thereof,
- e) causing said emitted UV energy, from said light pipe distal end, to be projected through an optical lens whereby said UV energy is radiated as a converging radiation field toward a distant focal point,
- f) passing said substrate through said UV converging radiation field between said optical lens and said focal point.

7. (New) The method as claimed in claim 6 including the step of preheating said imprinted UV curable ink image before passing said image through said converging, radiation field.

8. (New) A method of producing indelible ink imprinted indicia upon a selected substrate comprising:

- a) printing an image upon said substrate with UV curable ink,
- d) providing a UV energy source,
- e) providing a light pipe extending from said remote UV energy source whereby said UV energy may be transmitted through said light pipe and emitted from the distal end thereof,
- e) causing said emitted UV energy, from said light pipe distal end, to be projected through an optical lens whereby said UV energy is radiated as a converging radiation field above said focal point and an extended, diverging, radiation field below said focal point,
- f) passing said substrate through said diverging radiation field below said focal point.

9. (New) The method as claimed in claim 8 including the step of preheating said imprinted UV curable ink image before passing said image through said extended, diverging radiation field.

10. (New) Apparatus for curing UV curable ink imprinted upon a substrate comprising:

- a) an open ended elliptical reflector,
- b) an UV radiation source positioned at the foci of said elliptical reflector, such that the UV energy emitted from said UV energy source is convergingly directed to a common focal point thereby forming a converging radiation field,
- c) means for passing said ink imprinted substrate through said radiation field between said UV energy source and said focal point.

11. (New) The apparatus as claimed in claim 10 including means for preheating said ink imprinted image before passing said image through said radiation field.

12. (New) Apparatus for curing UV curable ink imprinted upon a substrate comprising:

- a) an open ended elliptical reflector,
- b) an UV radiation source positioned at the foci of said elliptical reflector, such that the UV energy emitted from said UV energy source is directed to a distant focal point thereby forming a converging radiation field, above said focal point and an extended, diverging radiation field below said focal point,
- c) means for passing said ink imprinted substrate through said extended, diverging radiation field.

13. (New) The apparatus as claimed in claim 12 including means for preheating said ink imprinted image before passing said image through said extended radiation field.

14. (New) Apparatus for curing an UV curable ink imprinted image upon a substrate comprising:

- a) an UV energy source,
- b) a light pipe extending from said UV energy source having a distal end whereby said UV energy may be transmitted through said light pipe to said distal end and emitted therefrom,
- d) an optical lens positioned such that said emitted UV energy may pass through said optical lens and exit therefrom as a converging radiation field having a distant focal point,
- b) means for passing said ink imprinted image through said converging radiation field between said optical lens and said focal point.

15. (New) The apparatus as claimed in claim 14 wherein said means for passing said ink imprinted image through said converging radiation field comprises an endless belt.

16. (New) The apparatus as claimed in claim 14 including means for preheating said ink imprinted image before said image passes through said diverging UV radiation field.

17. (New) Apparatus for curing an UV curable ink imprinted image upon a substrate comprising:

- a) an UV energy source,
- b) a light pipe extending from said UV energy source having a distal end whereby said UV energy may be transmitted through said light pipe to said distal end and emitted therefrom,
- d) an optical lens positioned such that said emitted UV energy may pass through said optical lens and exit therefrom forming a converging radiation field, above said focal point and an extended, diverging radiation field below said focal point,
- e) means for passing said ink imprinted image through said extended diverging UV radiation field.

18. (New) The apparatus as claimed in claim 17 wherein said means for passing said ink imprinted image through said diverging UV radiation field comprises an endless belt.

19. (New) The apparatus as claimed in claim 17 including means for preheating said ink imprinted image before said image passes through said diverging UV radiation field.

20. (New) Apparatus for printing an indelible, UV curable, ink imprinted image upon a substrate comprising:

- a) an enclosure,
- b) an endless belt for supporting said substrate thereupon, said endless belt encircling a pair of spaced apart rotatable cylinders within said enclosure, whereby said endless belt forms a first, forward moving planer surface between said cylinders and a second rearward moving belt portion,
- c) a planer support table, between said spaced apart cylinders, for supporting said first planer surface of said endless belt, said support table having an opening therethrough,
- d) an open ended housing positioned above said first planer surface of said belt and opposite said opening in said support table wherein said open end of said housing is aligned with said opening in said support table,
- e) an elliptical reflector positioned within said housing wherein the open end of said reflector is aligned with the open end of said housing and said opening within said support table,
- f) an UV energy source positioned within said reflector whereby the UV radiation field emitted, from said UV energy source, is convergingly directed through said opening within said support table to a focal point below said first planer surface of said endless belt,
- g) means for rotating said cylinders such that a desired linear velocity of said belt over said support table, in said forward direction, is achieved.

21. (New) The apparatus as claimed in claim 20 including means for producing a negative pressure gradient across said support table whereby said endless belt and said substrate thereupon is held firmly upon said support table as said endless belt traverses said table thereby causing said substrate to traverse said UV radiation field at a predetermined distance from said focal point.

22. (New) Apparatus for printing an indelible, UV curable, ink imprinted image upon a substrate comprising:

- a) an enclosure,
- b) an endless belt for supporting said substrate thereupon, said endless belt encircling a pair of spaced apart rotatable cylinders within said enclosure, whereby said endless belt forms a first, forward moving, planer surface between said cylinders and a second rearward moving belt portion,
- c) a planer support table, between said spaced apart cylinders, for supporting said first planer surface of said endless belt thereon, said support table having an opening therethrough,
- d) an open ended housing positioned above said first planer surface of said belt and opposite said opening in said support table wherein said open end of said housing is aligned with said opening in said support table,
- e) an UV energy source,
- f) a light pipe extending from said UV energy source having its distal end within said open ended housing, whereby said UV energy may be transmitted through said light pipe to said distal end and emitted therefrom,
- g) an optical lens positioned such that said emitted UV energy may pass through said optical lens and exit therefrom as a converging radiation field, extending through said opening in said support table, and having a focal point below said first planer surface of said endless belt,
- h) means for rotating said cylinders such that a desired linear velocity of said belt over said support table, in said forward direction, is achieved.

23. (New) The apparatus as claimed in claim 22 including means for producing a negative pressure gradient across said support table whereby said endless belt and said substrate thereon is held firmly upon said support table as said endless belt traverses said table thereby causing said substrate to traverse said UV radiation field at a predetermined distance from said focal point.

24 (New) The apparatus as claimed in claim 22 including means for preheating said ink imprinted image before said image passes through said UV radiation field.

25. (New) The apparatus as claimed in claim 10 wherein said elliptical reflector comprises two halves, each half rotatable about a pivot point whereby said open end of said reflector may be closed thereby terminating said converging UV radiation field.

26. (New) A printing machine for printing an indelible image upon a paper substrate comprising:

- a) an enclosure,
- b) an endless belt for supporting said substrate thereupon, said endless belt encircling a pair of spaced apart rotatable cylinders within said enclosure, whereby said endless belt forms a first, forward moving planer surface between said cylinders and a second rearward moving belt portion,
- c) means for rotating said cylinders such that a desired linear velocity of said belt over said support table, in said forward direction, is achieved.
- d) a planer support table, between said spaced apart cylinders, for supporting said first planer surface of said endless belt, said support table having an opening therethrough,
- e) means for creating a converging UV radiation field above said opening in said support table whereby said converging UV radiation field is projected through said opening in said support table converging at a focal point below said endless belt,
- f) means for placing said paper substrate upon said moving belt, whereby said paper substrate is transported, upon said belt, toward said converging UV radiation field,
- h) means, within said enclosure, for imprinting an UV curable, ink imprinted image upon said paper substrate as it moves upon said moving belt prior to said paper substrate passing through said converging radiation field,
- h) means for removing said paper substrate after it has passed through said converging radiation field.

27. (New) The printing machine as claimed in claim 26 wherein said means for creating said converging UV radiation field is a focused elliptical reflector.

28. (New) The printing machine as claimed in claim 26 wherein said means for creating said converging UV radiation field comprises:

- a) an UV energy source,
- b) a light pipe extending from said UV energy source having a distal end whereby said UV energy may be transmitted through said light pipe to said distal end and emitted therefrom,
- d) an optical lens positioned such that said emitted UV energy may pass through said optical lens and exit therefrom as a converging radiation field having a distant focal point.

29. (New) The printing machine as claimed in claim 26 including means for preheating said ink imprinted image prior to said ink imprinted image passing through said converging radiation field.

30. (New) The printing machine as claimed in claim 26 including means for creating a negative pressure, from top to bottom, across said support table whereby said endless belt and said paper substrate drawn downward upon the top surface of said support table.

31. (New) The method as claimed in claim 6 wherein step e includes providing a liquid filled light pipe

32. (New) The method as claimed in claim 8 wherein step e includes providing a liquid filled light pipe.

33. (New) The apparatus as claimed in claim 14 wherein said said light pipe is a liquid filled light pipe.

34. (New) The apparatus as claimed in claim 17 wherein said light pipe is a liquid filled light pipe.

35. (New) The apparatus as claimed in claim 22 wherein said light pipe is a liquid filled light pipe.

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36. (New) The printing machine as claimed in claim 28 wherein said light pipe is a liquid filled light pipe.